PALÉONTOLOGIE

A Frenchman in Patagonia: the palaeontological expeditions of André Tournouër (1898-1903)

Un Français en Patagonie : les expéditions paléontologiques d'André Tournouër (1898-1903)

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Summary: In the course of three expeditions, from 1899 to 1903, the Frenchman André Tournouër (1871-1929), who had been raising cattle in northern Argentina, excavated various fossil localities in Argentinian Patagonia and brought together large palaeontological collections that he sent to the National Museum of Natural History in Paris. Hitherto unpublished or little known documents shed some light on Tournouër's collecting expeditions, about which relatively little was known. His relations with Albert Gaudry and Florentino and Carlos Ameghino are discussed, as well as the funding sources available for his field work, the shipping methods he used and his cryptozoological activities in search of the "mysterious animal of Patagonia". Tournouër's contributions to the geology and palaeontology of Patagonia were considerable and the collections he brought together are still being studied by palaeontologists today. However, he published relatively little about his discoveries and stopped his palaeontological activities soon after he returned from his last expedition in Patagonia. The possible reasons why this wealthy man turned to other pursuits are discussed.

KEY-WORDS

Tournouër
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Résumé : Au cours de trois expéditions, de 1899 à 1903, le Français André Tournouër (1871-1929), qui auparavant élevait du bétail dans le nord de l'Argentine, fouilla divers gisements fossilifères en Patagonie argentine et rassembla de vastes collections paléontologiques qu'il envoya au Muséum National d'Histoire Naturelle à Paris. Des documents jusqu'ici inédits ou peu connus fournissent des informations nouvelles sur les expéditions de Tournouër, sur lesquelles on savait relativement peu de choses. Ses relations avec Albert Gaudry et avec Florentino et Carlos Ameghino sont discutées, de même que ses sources de financement, les méthodes de transport des collections utilisées et ses activités cryptozoologiques à la recherche de « l'animal mystérieux de la Patagonie ». Les contributions de Tournouër à la géologie et la paléontologie de la Patagonie furent considérables et les collections qu'il amassa sont encore étudiées par les paléontologues d'aujourd'hui. Pourtant, il publia relativement peu de chose sur ses découvertes et cessa ses activités paléontologiques peu de temps après son dernier voyage en Patagonie. Les raisons possibles pour lesquelles cet homme fortuné se tourna vers d'autres activités sont discutées.

MOTS-CLÉS

Tournouër
Patagonie
Paléontologie
Collections
Gaudry
Ameghino

Introduction

During the last decade of the 19th century and the first years of the 20th, the fossil-bearing formations of Argentinian Patagonia attracted much attention among the international palaeontological community. In particular, the often unusual Cretaceous and Cenozoic vertebrates they yielded gave rise to controversies about their geological age and systematic affinities. While Argentinian palaeontologists, at the forefront of them Florentino Ameghino and

his brother Carlos (Podgorny, in press), were especially active in collecting and describing Patagonian fossils (in intense competition with the collectors from the La Plata Museum sent by Francisco Moreno), scientific institutions from other countries, notably the United States, also sent palaeontological expeditions to Patagonia (see Simpson, 1984, for a general account). As a result, large collections of fossils found their way to museums outside Argentina. The Muséum National d'Histoire Naturelle (MNHN) in Paris holds a large number of Patagonian fossils that were collected between 1898 and 1903 by André Tournouër (1871-1929). Although his name is not completely forgotten, and he is mentioned in various articles and books about the history of palaeontological research in Patagonia, what has been written about his life and work is scanty and often erroneous, partly because he published relatively little about his discoveries and left no detailed account of his expeditions. In the present paper, after providing a short biographical sketch (see also Buffetaut, 2016a), I try to reconstruct some aspects of Tournouër's collecting activities in Patagonia, on the basis of his published papers (some of them poorly known) and of hitherto unpublished documents in the palaeontology library of the MNHN. Quotations in French have been translated into English by myself.

Biographical sketch

As noted above, part of what has been written about André Tournouër is erroneous. Even his name has been misspelled: the American palaeontologist Loomis consistently called him "Tournier" (Loomis, 1914). Martinic (1996) misspelled it as "Tourneur". Mistakes were made about his given name, too. In 1903, Tournouër gave a talk at the Société des Américanistes de Paris about his travels in Patagonia, and for some reason the anonymous author of the report on this talk called him "Paul Tournouër" (Anonymous, 1904). Simpson (1984: 94), who corrected Loomis's mistake, made a possibly even worse one in claiming that "*In 1878 and 1879 André Tournouër himself had abstracts of two studies on fossil horses published in the bulletin of the Geological Society of France*". André Tournouër was 7 and 8 years old, respectively, in 1878 and 1879, and the papers were of course authored by his father Raoul (see below), who was mainly interested in fossil invertebrates but occasionally studied vertebrates, too (see Fischer, 1885 for Raoul Tournouër's list of publications, including the papers on fossil horses).

André Tournouër (**Fig. 1**) belonged to a wealthy upper-class family. His father, Jacques Raoul (usually called Raoul) Tournouër (1822-1882), a lawyer by training, had been an auditor at the Council of State. He gave up this position in 1851, when the Second French Republic was overthrown by Louis-Napoléon Bonaparte and replaced by the Second Empire. He then devoted himself to painting and science, becoming a well known stratigrapher and palaeontologist, specializing in fossil invertebrates (Fischer, 1885). In 1877 he was elected president of the French geological society. In the course of his palaeontological researches he befriended Albert Gaudry (1827-1908), then professor of palaeontology at the National Museum of Natural History in Paris. They collaborated on the study of the Miocene fauna from Mount Luberon in Provence. This friendship was to play an important part in the origination of André Tournouër's expeditions to Patagonia.

Fig. 1. André Tournouër (after Buffetaut, 2013).

Little is known about André Tournouër's early life, except that he was born in 1871. The work he did in Patagonia shows that he had a rather thorough knowledge of geology and palaeontology, but whether he studied geology at a university is not known. Training by his father must have been limited, since the latter died when André was only 11 years old. Sometime in the early 1890s (in 1902 he wrote that he had

resided in Argentina for 10 years), André Tournouër settled in Mendoza, Argentina, where he raised cattle. The reasons for this move are not known, but it proved determinant for his palaeontological activities. There is every indication that for most of his life he lived off his private income. His successive addresses, as given in the annual lists of members published by the French geological society (of which he became a member in 1900), are all in the posh districts of Paris and Le Havre, or at a castle in the vicinity of Paris, and the lists do not mention any professional occupation. André Tournouër returned to France sometime after his last expedition to Patagonia in 1903. In 1906 he married Isabelle Latham, heiress to a wealthy family of shipowners from Le Havre in Normandy, and around 1910 he settled in that city, where he became a founding member of the Société linnéenne de la Seine-Maritime (Buffetaut, 2013). According to the records of the French geological society, he returned to Paris in the 1920s and died there in 1929, aged 58.

André Tournouër's expeditions to Patagonia

How André Tournouër's expeditions to southern Patagonia began has been told by Gaudry in his both grandiloquent and sentimental style (my translation): "*One day, as he [André Tournouër] was back from Mendoza, I told him about the discoveries made by Messrs Ameghino and Mr Moreno in Patagonia; I asked him to undertake excavations, in order to do like his father and honour French science. When he heard his father's name, he gave me a deep and affectionate look: "I shall try to do like him", he told me; "I shall go to Patagonia, the Paris Museum will have fossils". He bravely kept his word*" (Gaudry, 1906). The timing and number of Tournouër's expeditions to Patagonia has long been somewhat obscure. Gaudry (1906) mentions six "excavations". Simpson (1984) is rather vague about this. However, Tournouër, both in a brief note about his palaeontological researches (Tournouër, 1902) and in his last paper about Patagonia (Tournouër, 1922), clearly stated that he first went to Patagonia from November 1898 to May 1899. He was there again from September 1899 to June 1900. He made a third trip from August 1901 to an unspecified date in 1903 (possibly February – he definitely was in Paris in May 1903: Anonymous, 1904). He temporarily left the expedition in 1902 to bring important *Pyrotherium* specimens to France himself. Uncertainties about the number of his trips to Patagonia probably stem from the fact that, for obvious reasons considering the Patagonian climate, he went there during the southern summer, so that his field campaigns were usually astride two successive years.

Before he launched his first expedition, Tournouër made preparations for it. An important point is that he visited Florentino Ameghino. The meeting had been prepared by Gaudry, who had met Ameghino during the latter's long stay in Paris (from 1878 to 1881). On 1st June 1898, Gaudry wrote a letter to Ameghino (Torcelli, 1935, letter 1309) in which he mentioned that the latter may have met Raoul Tournouër during his stay in Paris and went on to explain that his son André, who owned property in Mendoza, was planning to visit Patagonia and to collect fossils for the Paris Museum (which, contrary to the museums in London and Munich, had no such specimens – the London and Munich specimens had mainly been acquired from Ameghino). Gaudry therefore recommended André Tournouër to Florentino Ameghino and asked him to receive him. Ameghino complied and on 25 July 1898 (Torcelli, 1935, letter 1313) reported to Gaudry (whom he addressed as "*dear colleague and learned master*") that he had met André Tournouër and had provided him with all the necessary information for successful collecting in Patagonia, adding that he was likely to find abundant material in the Santa Cruz beds but that this was less likely in the *Pyrotherium* beds, in which mammal remains were not common. After this initial meeting, relations between Tournouër and Florentino Ameghino were cordial, as shown by the latter's published correspondence (Torcelli, 1935, 1936). However, Florentino Ameghino did not collect fossils himself in Patagonia, leaving that task to his brother Carlos, who spent many months there in the course of 14 expeditions, from 1887 to 1903 (Ameghino & Ameghino, 2006, Podgorny, in press). Tournouër regularly wrote to Ameghino, sometimes sending him photographs of his excavations (Torcelli, 1936, letter 1919), to keep him informed of his discoveries or to arrange meetings with him in La Plata when he stopped in Buenos Aires on his way to France. Ameghino's correspondence occasionally mentions such visits. For instance, in a letter sent to his brother Carlos on 30 June 1900 (Ameghino & Ameghino, 2006), he noted that Tournouër had visited him and had told him about his collecting trips to lake Colhue-

huapi and the Santa Cruz area, but could not show him the fossils, as they had already been sent to France. Tournouër had also mentioned that he intended to go back to Chubut and look for the mysterious "Jemmisch", which he had seen briefly and had unsuccessfully tried to shoot (see below). When in Patagonia, Tournouër also met Florentino Ameghino's brother Carlos and occasionally accompanied him in the field. Although relations were apparently very good between Florentino and Tournouër, they may have been a little more strained with Carlos. In a letter to his brother of 1899 quoted by Madden and Scarano (2010), Carlos explained that he had sent Tournouër off to Gran Barranca to get rid of him, as, having found very little so far, he was inquiring about where to go to find fossils. In a letter of 29 November 1902, Florentino asked his brother to try to be agreeable "*if possible*" with Tournouër, who was going back to his Deseado localities and was likely to meet him (Torcelli, 1936, letter 1491). His friendship was useful to them, he added, because the reports he sent to European palaeontologists, as well as his papers, were in their favour "*on all points*", and he asked his brother to provide Tournouër with information as accurate a possible. Ameghino was glad when Tournouër confirmed his views on some aspects of the stratigraphic succession in southern Patagonia, although they disagreed on the exact ages of the formations (see below).

Florentino Ameghino visited southern Patagonia only once, in 1903 (Podgorny, in press), to see by himself the places where his brother Carlos had been working for more than a decade, and on that occasion the brothers met Tournouër in the field, as mentioned in a letter from Florentino to the latter, dated 1 July 1903 (Torcelli, 1936, letter 1931), in which he mentioned the good memories he had of this trip in his "agreeable company" – a trip during which they checked some stratigraphic points.

Unlike other palaeontologists working there at the turn of century, including the Ameghino brothers and American researchers such as Hatcher, Brown and Loomis, who usually reached the fossiliferous areas from ports on the Atlantic coast, Tournouër initially did not go to Patagonia by sea. Instead, in 1898 he travelled all the way from Mendoza to southern Patagonia (some 1600 km) along the eastern slopes of the Andes with his workers, their equipment and a team of 40 mules (Tournouër, 1922).

Two relatively detailed accounts of all of Tournouër's expeditions are given in two of his papers (Tournouër, 1902; 1922). A map showing the main areas he visited in the course of his palaeontological explorations (**Fig. 2**) was first published in 1903 (Tournouër, 1903) and reproduced in his last paper (Tournouër, 1922). His accounts can be summarized as follows.

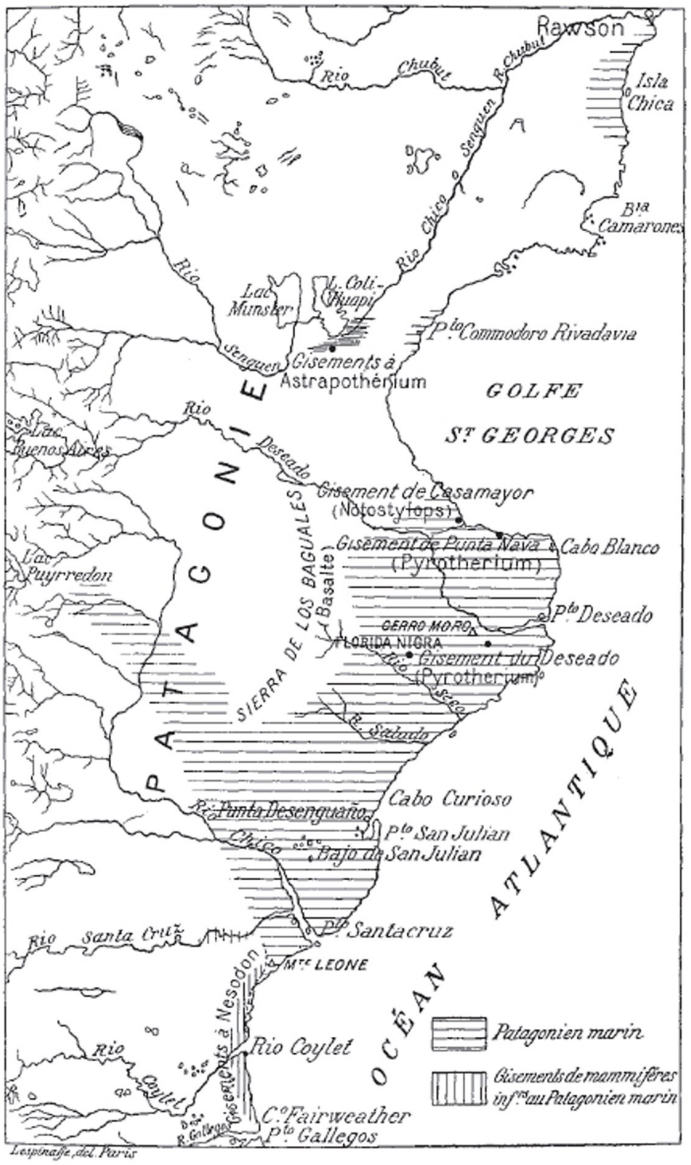

Fig. 2. Map showing the main fossiliferous areas in Patagonia visited by André Tournouër (from Tournouër, 1903b). The spellings used by Tournouër are not always those currently in use.

Tournouër's first expedition took place from November 1898 to May 1899. After travelling overland, along the Andes, from Mendoza to the Rio Senguer area of southern Patagonia with his men and mules, as noted above, he worked in the vicinity of lake Colhue-Huapi (which he spelled Coli-Huapi), or "Red Lake", in southern Chubut province, an arid and remote area a long distance (60 km) from the nearest settlement, where food and drinking water had to be brought from afar.

The specimens collected during this expedition were donated to the Paris Natural History Museum. The second expedition took place from September 1899 to June 1900. Via Punta Arenas in Chile, Tournouër met his men, who had overwintered near the coast, at the port of Comodoro Rivadavia. They mainly worked the continental deposits of the Santa Cruz Formation at "Monte Leone" (Monte León) near the town of Rio Gallegos, collecting abundant fossil mammal remains, notably belonging to the notoungulate Nesodon. Tournouër observed that the Santa Cruz Formation clearly overlies the marine beds of the Patagonian Formation, a fact already observed by Carlos Ameghino.

Tournouër's third expedition, funded by the French Ministry of Public Instruction and the Paris Natural History Museum, took place from August 1901 to 1903. He collected more Santacrucian fossils, including a large number of mammals, in the "Rio Coylet" (Rio Coyle) area of Santa Cruz province (Vizcaíno *et al.*, 2013). He then moved to the Rio Deseado region, farther north, where he excavated the "*Pyrotherium*" beds (now referred to the Deseadan South American Land Mammal Age). Some of the *Pyrotherium* specimens he collected were deemed so important that he interrupted his stay in Patagonia in 1902 to take them to Paris, where they were eventually described in a posthumous paper by Gaudry (1908). Tournouër's note entitled "*Recherches paléontologiques en Patagonie*", presented at the French Academy of Sciences on 6 October 1902, must have been written during this visit to Paris (Tournouër, 1902). He then returned to the Deseado area in late 1902 and the excavations went on until 1903. This was Tournouër's last expedition to Patagonia. By May 1903 he was back in Paris (on 5 May he gave a talk about his travels at the *Société des Américanistes*: Anonymous, 1904).

Some information about the practical aspects of Tournouër's expeditions is provided by photographs kept in the palaeontology library of the MNHN; they are mounted on cardboard and bear captions written in pencil on the back. Two of the photographs show excavations in the Deseado beds (*Pyrotherium* beds) during the November 1902-February 1903 field campaign, probably at the locality referred to as "La Flecha" by Tournouër (1903) – the name also appears in a letter to Ameghino dated 19 March 1903 (Torcelli, 1936, letter 1919) in which Tournouër mentions that he includes photos of the excavations at that locality (**Fig. 3A, B**). They show several workmen wielding pickaxes in a

Fig. 3 A. Photograph of André Tournouër's excavations in the Deseado beds (probably "La Flecha" locality), taken during his last expedition (1901-1903), kept in the library of the palaeontology department of MNHN. Courtesy of MNHN.

Fig. 3 B. Photograph of André Tournouër's excavations in the Deseado beds (probably "La Flecha" locality), taken during his last expedition (1901-1903), kept in the library of the palaeontology department of MNHN. The man standing on the edge of the excavation may be André Tournouër (?). Courtesy of MNHN.

rather chaotic-looking pit; no fossils are clearly visible. Another photograph, taken at the Deseado camp, shows a mule laden with crates, illustrating how fossils were carried to the coast, 45 km distant (**Fig. 4A**). The difficulty of procuring even basic commodities, mentioned by Tournouër (1922), is illustrated by a photograph showing a mule carrying several containers filled with drinking water (**Fig. 4B**).

A photograph (**Fig. 5**) shows a rugged landscape in Chubut province, the "Colihüe cliffs"

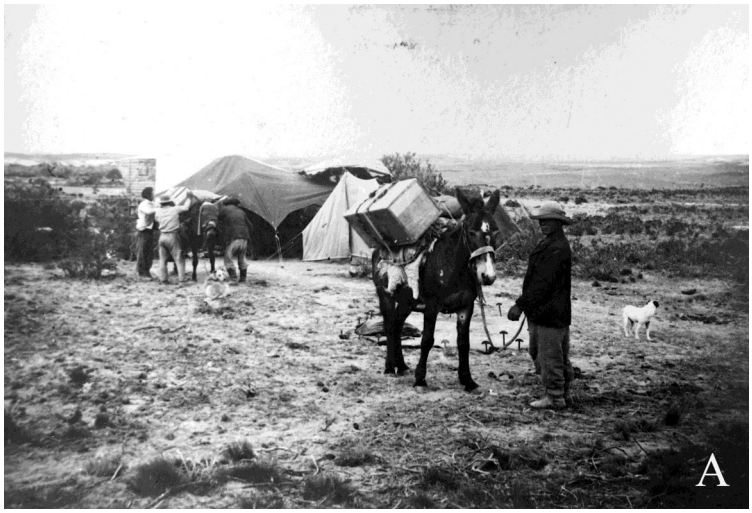

Fig. 4 A, B. Mules carrying fossil specimens to the coast (**A**) and containers for drinking water (**B**) at the Deseado camp, 1901-1903 expedition. Photographs kept in the library of the palaeontology department of MNHN. Courtesy of MNHN.

Fig. 5. Photograph probably taken during Tournouër's first expedition (1898-1899), showing a landscape near lake Colhue Huapi in Chubut province, possibly Gran Barranca, with mules and a member of Tournouër's crew in the foreground. Small crosses indicate significant geological spots in the distance (see text for explanations). Photograph in the library of the palaeontology department of MNHN. Courtesy of MNHN.

near lake "Coli Huapi" [Colhué Huapi] – possibly Gran Barranca. It must have been taken during Tournouër's first expedition of 1898-99, apparently the only time when he worked in that area. It bears at the back a long handwritten explanation which illustrates how some of Tournouër's field observations led him to question some of Ameghino's assumptions. The photograph, taken at a place "*eight days away from the coast with mules*", shows the "*silicified wood stage*", the mountains being "*absolutely full of silicified wood*". A small cross added in ink on the photo shows where Tournouër found bones of "*gigantic dinosaurs*". Two crosses farther to the right indicate geologically higher beds at the top of which remains of *Astrapotherium* and other fossils have been collected and sent to the Paris Museum. The "*Guaranian*" (or *Pyrotherium* stage) is said to be 100 metres thick in that area. Most importantly, the final sentence reads "*Mr Tournouër believes that Mr Ameghino has been misled when he was told that a* Pyrotherium *tusk had been found together with dinosaurs. At lake Colue Huapi the beds with dinosaurs and silicified wood are always below the* Pyrotherium *beds*". Ameghino's belief that the advanced mammals from the *Pyrotherium* beds had been contemporaneous with dinosaurs and were therefore Cretaceous in age was thus shown to be unfounded on the basis of stratigraphic field evidence.

A failed attempt at collecting a *Neomylodon* specimen

A somewhat unusual episode in André Tournouër's expeditions was his encounter with a mysterious creature in a river somewhere in Chubut Province. He described his experience in two brief notes published in esteemed French scientific journals, the *Bulletin du Muséum d'Histoire Naturelle* and the *Comptes Rendus hebdomadaires des séances de l'Académie des Sciences* (Tournouër, 1900; 1901), the editors of which apparently had no qualms about publishing papers that today would fall within the scope of cryptozoology. Gaudry, who thought that giant ground sloths would probably be found alive (Gaudry, 1899), presented Tournouër's note at the Academy of Sciences and certainly supported the publication of his other paper by the Paris Natural History Museum. It should be remembered that at that time the possible survival of giant sloths was seriously discussed in scientific circles, following the discovery of apparently fresh *Mylodon* skin in the Ultima Esperanza cave in Chilean Patagonia in 1895 (Martinic, 1996; Pérez *et al.*, 2018). One of the main contributors to the debate was Florentino Ameghino, who in 1898 had coined the name *Neomylodon listai* for the purported surviving giant sloth, basing his belief in its existence on tales told by local Indians, some osteoderms embedded in a piece of skin collected at an unspecified location in Patagonia and a rather obscure report by the late explorer Ramón Lista, who had told him that, when travelling in Santa Cruz Province, he had seen an animal looking like a hairy pangolin and had unsuccessfully tried to shoot it (see Pérez *et al.*, 2018 for a discussion of the uncertainties about the real origin of the osteoderms and skin described by Ameghino – which in all likelihood came from the Ultima Esperanza cave). Ameghino's report had been republished

in various languages in several countries and had excited much attention. According to Ameghino, the mysterious animal, which had semi-aquatic habits, was called *Iemisch* by the Tehuelche Indians, who were extremely afraid of it (Ameghino, 1899).

According to his reports, Tournouër's encounter with the mysterious animal, which he called Hyimché, took place one evening on the banks of an unspecified river in the interior of Patagonia during his second expedition (September 1899-June 1900). What he saw was the head of an animal emerging from the water. It was round, the size of the head of a puma, dark brown in colour with lighter spots around the eyes and no visible external ears. He tried to shoot it but could not find the body when he looked for it along the river banks. The local Indians confirmed that what he had seen was the *Hyimché*, an animal of which they were much afraid. He was later shown on a sand bank large cat-like footprints, supposedly made by the *Hyimché*. His conclusion was that the *Hyimché* did exist but was probably not Ameghino's *Neomylodon*, because according to the Indians it had large canines, which was incompatible with a sloth (Tournouër, 1900; 1901). As he told Ameghino, he hoped to collect more evidence about that mysterious animal during his next expedition. Tournouër's encounter with the *Hyimché* has been mentioned in various cryptozoology books (e.g. Heuvelmans, 1955; Whittall, 2012). What has escaped most authors, however, is that Tournouër changed his mind about that enigmatic animal (Buffetaut, 2016b). When he gave a talk about his travels in Patagonia at the *Société des Américanistes de Paris* on 5 May 1903, he was asked about the "Néo-Mylodon". He replied that in his opinion it was a legend based on a local species of otter with a very long and flexible tail (Anonymous, 1904) – he presumably meant the southern river otter, *Lontra provocax*. Why he changed his opinion is unclear, but an otter certainly was in agreement with what he had seen swimming in a river. Moreover, the ethnologist Lehmann-Nitsche (1902) had shown that *Iemisch* and similar names such as *Hyimché* were designations for the otter, and this may have influenced Tournouër's interpretation of the mysterious animal.

Funding the expeditions

How Tournouër's expeditions were funded can be reconstructed to some extent, on the basis of published and unpublished documents, the latter kept at the palaeontology library of MNHN.

It appears that the early expeditions were at least partly funded by the sale of fossils collected in Patagonia to the Paris Natural History Museum. A copy of a letter dated 23 August 1900, from Georges Leygues, then minister of public instruction, to the director of the Paris Museum (at that time the zoologist Edmond Perrier), mentions that on the latter's request a sum of 1495 francs, taken from the Serres bequeath (Serres had been a professor of comparative anatomy at the Paris Museum), is made available for the purchase of a collection of fossil bones sold to the Museum by Mr Tournouër. Although it is difficult to estimate reliably what this sum means in terms of modern currency, it clearly was a fairly large amount of money and may have covered a large part of Tournouër's expenses during his first two expeditions. In 1902, with Gaudry's support, Tournouër received the Jérôme Ponti prize of the French Academy of Sciences, for important scientific work. The Ponti prize at that time amounted to 3500 francs. In his report, Gaudry (1902) mentioned that Tournouër's collecting expeditions had been carried out at his own expense. By purchasing the fossils, the Paris Museum refunded at least part of the expenses and that was later complemented by the Ponti prize. In 1904 Tournouër received the Fontannes prize of the French Geological Society, which amounted to 500 francs; however, by that time he had ceased his expeditions to Patagonia.

Tournouër (1922) noted that the 1901-1903 expedition took place "*under the auspices*" of the French Ministry of Public Instruction and the Paris Natural History Museum. This apparently implies that he received financial support from these institutions. This is confirmed by an interesting handwritten letter in the palaeontology library, which provides some evidence about the way the funds were made available to André Tournouër. It was sent to Albert Gaudry by Cécile Tournouër, André's mother, from Le Lude (a castle in the Sologne region of central France), on 8 April of an unspecified year. However, in it she mentions the recent birth (two days before) of her grand-daughter Renée Bastide du Lude, whose mother Suzanne was the daughter of Raoul and Cécile Tournouër and therefore André's sister. As Renée was born in 1902, the letter must have been written

on 8 April 1902. Cécile Tournouër addresses Gaudry as her "*dear friend*", showing that the links between the professor of palaeontology and the Tournouër family went well beyond a mere professional acquaintance. After announcing the birth of her grand-daughter, Cécile Tournouër adds (my translation):

> "*I have a request for money from André and if you can put at my disposal the 2000 frs you provide for him, I have the necessary documents to get them and can be in Paris in the first days of next week. I look forward to seeing the 26 new crates*".

The crates must have contained fossils sent by André, who apparently still was in Patagonia although it is known that he came back to France for some time in 1902 (if he had been in France he would have collected the money himself). The 2000 francs must have been part of the funds allotted to him by the Natural History Museum.

Shipping the fossils to France

Documents in the palaeontology library of the MNHN provide interesting information about the way the specimens collected by Tournouër were shipped to France. They consist of receipts from various shipping and railway companies and document how the crates of fossils found their way to the Paris Natural History Museum after they had been carried to a port somewhere on the Patagonian coast. A receipt from the *Compagnie des Messageries Maritimes* (the steamboat company of the French Mail) thus lists 6 boxes sent from Buenos Aires to Bordeaux on the steamboat *Cordillère* in February 1900, close to the end of Tounouër's second expedition. The boxes were to be delivered to the Natural History Museum and shipping costs were 150 francs. They had been received in Buenos Aires from a Mr Santiago Sorren, probably an agent commissioned by Tournouër.

Not all fossil shipments were sent from Buenos Aires, however. A letter sent by the shipping company Pasinovich and Boisdechêne, based in Punta Arenas, in Chile, dated 4 January 1902, informed the Paris Natural History Museum that a consignment of 3 crates had been sent, by order of Mr A. Tournouër, on board the steamer *Lake Megantic*, which belonged to the British *Pacific Steam Navigation Company*. As shown by a letter from the agent of the company in France, the crates had arrived in France by 10 February 1902. A second consignment of 13 crates from Punta Arenas arrived in France in May 1902 on another steamer of the same company, the *Orellana*.

The 1902 shipments were unloaded at La Pallice, the deep-water port near La Rochelle on the French Atlantic coast. Going through customs at La Pallice was facilitated by the Ministry of Finance on request from the Natural History Museum, as shown by a typewritten letter dated 18 February 1902. Receipts also show that the crates of fossils were sent from La Pallice to Paris by express train.

Why Tournouër chose to ship his fossils from Punta Arenas in Chile rather than from Buenos Aires via one of the ports on the Atlantic coast of Argentinian Patagonia can be explained by the fact that ships to Buenos Aires from these ports were mainly used by the military and travelled at irregular intervals (Irina Podgorny, pers. com.). By contrast, the Punta Arenas port was an important stop on the shipping lines from the west coast of South America to Europe and therefore provided more regular and faster service. How the consignments of fossil specimens were taken from the collecting areas to Punta Arenas is unclear.

The scientific significance of André Tournouër's expeditions to Patagonia

The immediate result of André Tournouër's expeditions was that the Paris Natural History Museum obtained a vast colllection of fossils from Patagonia (Gaudry repeatedly mentioned the very large number of specimens sent to Paris by Tournouër). Lists of taxa collected during the expeditions were provided in several papers (Tournouër, 1902; 1903; 1904; 1906a,b; 1908; 1909). The significance of the finds was clearly appreciated as soon as the fossils reached Paris, as shown by Gaudry's enthusiastic comments. Some of the specimens contributed considerably to a better knowledge of some spectacular taxa that had hitherto been relatively poorly known, a case in point being that of *Pyrotherium* (**Fig. 6**), the remains of which were deemed so important that Tournouër interrupted his field work to bring them himself to Paris. There is no published comprehensive catalogue of the fossils collected byTournouër but the papers on fossils from that collection by various authors, including many published well after the initial

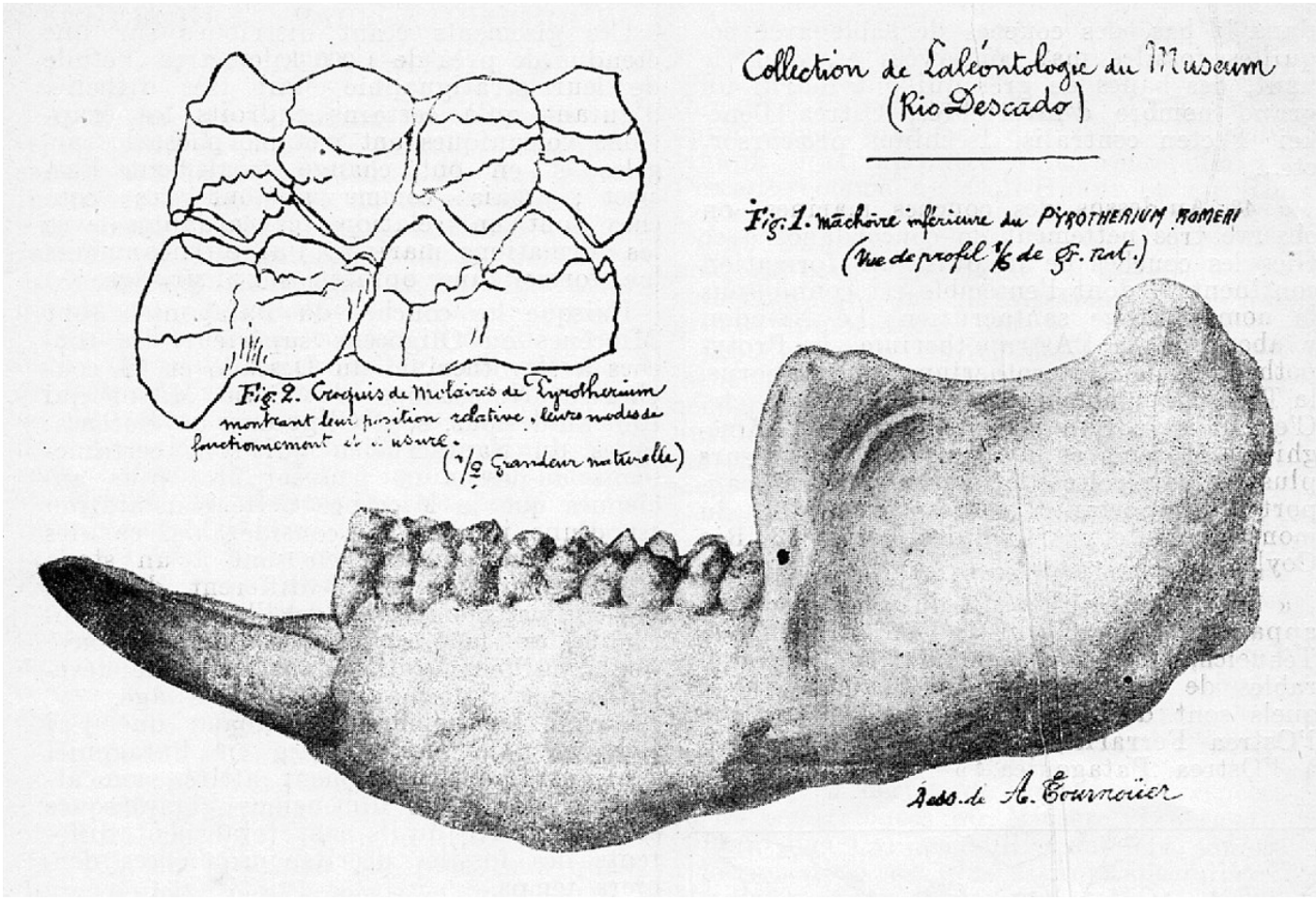

Fig. 6. *Pyrotherium* teeth and lower jaw collected in Patagonia by André Tournouër, in the collections of the palaeontology laboratory of MNHN. Drawing by A. Tournouër, from his 1922 paper.

descriptions by Gaudry and Tournouër himself, testify to its extent and diversity (e.g. Hoffstetter, 1954; Simpson, 1964; Marshall *et al.*, 1984; Billet, 2010; Buffetaut, 2014; Koenigswald *et al.*, 2015; Houssaye *et al.*, 2016; Novo *et al.*, 2018). The Tournouër collection is certainly one of the largest collection of Tertiary vertebrates from Patagonia in Europe. Ameghino himself acknowledged its importance in a letter to Marcellin Boule (Gaudry's successor at the MNHN) dated 22 December 1903 (Torcelli, 1936, letter 1963) in which he asked for casts of fossils collected by Tournouër that were not represented in the collections of the Natural History Museum in Buenos Aires. A detailed analysis of the scientific articles that have dealt with it is beyond the scope of this paper, but is should be mentioned that it is largely on the basis of fossils collected by André Tournouër that Albert Gaudry came to the conclusion that the Tertiary mammal faunas from Patagonia were the result of endemic evolution. This interpretation, which diverged strongly from Ameghino's views, according to which most of the major orders of mammals had originated from Patagonia, has proved correct: the unusual vertebrates from the Tertiary of South America evolved in isolation during the long period when the South American continent was separated from other land masses. As early as 1902, in a short paper in which he praised Tournouër's work in Patagonia, Gaudry emphasized the peculiarities of the Patagonian fossil mammals and suggested that their evolution had taken place on a vast “austral continent” on which faunal development had been different from that of the boreal regions (Gaudry, 1902). He later developed this idea in various papers on the fossils collected by Tournouër (e.g. Gaudry, 1906b; 1907).

André Tournouër's expeditions to Patagonia also allowed him to discover new important fossiliferous outcrops and to clarify the stratigraphic position of several significant fossil-bearing formations (Buffetaut, 2016a). Despite Simpson's claim that they were first explored by Carlos Ameghino (Simpson, 1967), there is strong evidence to show that the outcrops known as Gran Barranca, south of lake Colhue-Huapi, which provide a remarkable section of pre-Santacrucian fossil-bearing formations,

were actually discovered by Tournouër in 1899, as discussed in detail by Madden and Scarano (2010). Another locality discovered by Tournouër was in a gully on the coast of Santa Cruz Province that yielded fossils of Casamayorian (Eocene) age; the Ameghino brothers named it "cañadon Tournouër" (Simpson, 1967).

One of Tournouër's major scientific contributions resulting from his field work in Patagonia was to disentangle the stratigraphic relations between several Cenozoic formations and to help dating them on the basis of biostratigraphic evidence. He was able to confirm Ameghino's views on the succession of major Cenozoic fossil-bearing units, showing, for instance, that the Santa Cruz beds overlie the marine Patagonian Formation, which itself lies above the Deseado beds (this succession had been doubted by American palaeontologists). However, he disagreed with Ameghino about the ages of these formations. It is well known that Ameghino consistently overestimated the age of most of the fossil-bearing beds of Patagonia (e.g. Ameghino, 1902). In addition to his spectacular finds of terrestrial vertebrates, Tournouër collected abundant marine fossils, which he sent to experts in France for identification and dating (Priem for fishes, Canu for bryozoans, Lambert for echinids, Cossmann for molluscs). Several of them published papers on Tournouër's specimens (Lambert, 1903; Canu, 1904). While stressing that Ameghino had been correct about the stratigraphic succession of the various formations, Tournouër (1903) summarised the biostratigraphic results about the Patagonian Formation by stating that its fauna was Miocene, or possibly Oligocene, in age. The *Notostylops* and *Pyrotherium* beds, being overlain by the Patagonian Formation, could not be later than the Late Oligocene and the *Nesodon* beds above it could not be older than Miocene. These biostratigraphical conclusions have proved to be basically correct. Ameghino was pleased to see his conclusions about the succession of the formations validated, but could not accept the ages suggested by the French palaeontologists, which where much too young to his taste (he believed that the Santa Cruz beds and the Patagonian Formation were Eocene and that the *Pyrotherium* beds were Cretaceous: Ameghino, 1902). In a letter to Tournouër of 1st July 1903, he acknowledged that the fossil invertebrates had been submitted to authorities on conchiology in France but despite this he could not accept a Neogene age for the Patagonian Formation and was convinced that the authorities in question were mistaken (Torcelli, 1936, letter 1931). Until the end of his life, Ameghino persisted in overestimating the geological age of the fossil-bearing formations of Patagonia (Ameghino, 1910).

Conclusions: after the expeditions

André Tournouër came back to France in 1903 and there is no evidence that he ever went back to Argentina. His last real research paper, a very brief note on the forefeet of *Astrapotherium*, was published in 1905 in the *Bulletin de la Société géologique de France* (Tournouër, 1905) – his later papers in the *Bulletin de la Société linnéenne de la Seine-Maritime* were a brief review of the fossil vertebrates of Patagonia (Tournouër, 1914) and a short but useful record of his expeditions to Patagonia and their main results (Tournouër, 1922). It therefore appears that Tournouër stopped doing any active palaeontological research soon after his 1905 paper was published. Gaudry (1902) had announced that Tournouër was planning to study the fossils he had collected after his return from his next (and last) expedition. In fact, it was Gaudry himself who published most of the early descriptions of Patagonian fossils collected by Tournouër (Gaudry, 1908). There is no real evidence, however, of a competition between Gaudry and Tournouër about who would describe the material. Both men repeatedly declared their friendship and mutual respect, and the specimens were in such large numbers that they could provide work for more than one researcher. Why Tournouër did not continue his palaeontological activities after 1905 is unclear. Although the papers he published about the geology of Patagonia show that he had a solid background in field geology and stratigraphy, it cannot be excluded that he may have been more interested in collecting fossils than in describing them. One could also suppose that Gaudry's support and encouragement were so important to Tournouër that when his mentor died he did not feel like continuing his scientific researches (Marcellin Boule, who had succeeded Gaudry as professor of palaeontology at the Paris Museum in 1902, does not seem to have been especially interested in Tournouër's fossils beyond the fact they were very welcome additions to the collections). This, however, is not likely because

Gaudry died in November 1908, three years after the publication of Tournouër's 1905 paper on the feet of *Astrapotherium*. As noted above, Tournouër married Isabelle Latham in 1906, and this may have something to do with the end of his research activities, although his move to Le Havre took place some years later. It should also be mentioned that Tournouër, who was never officially employed as a palaeontologist, had other interests besides fossils. One of them was ballooning. It is recorded (Leroy, undated), for instance, that on 20 May 1909, the balloon *Nephtys*, manned by the Count of Castillon, Bastide du Lude (André Tournouër's brother in law) and Tournouër, took 4h55 to fly the 99 km between Saint-Cloud (in the western suburbs of Paris) and Elbeuf, in Normandy. After he settled in Le Havre, opportunities to work on fossils kept at the Paris Museum became curtailed. However, Tournouër never completely lost his interest in Patagonia and the fossils he had collected there, as shown by his two articles in the *Bulletin mensuel de la Société linnéenne de la Seine-Maritime*. There may have been a touch of dilettantism in Tournouër, who apparently switched effortlessly from cattle-raising to palaeontology and then to ballooning – and obviously never lost his upper-class connections and way of life. Be that as it may, his career as an active palaeontologist was brief (less than ten years) but highly productive in terms both of his contribution to the Cenozoic stratigraphy of Patagonia and of the remarkable collections he brought together.

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